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MINE COUNTERMEASURES(U) NAVAL INTELLIGENCE SUPPORT
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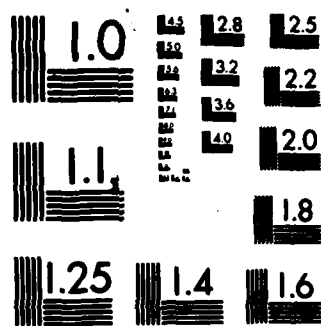


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MINE COUNTERMEASURES

[Fregattenkapitän Hartmut Spieker: Soldat und Technik, D 6323 E, Vol. 2, Feb. 1983, pp. 72 - 78; German]

"As I recall, we dropped only six or eight mines in a string right across the harbor entrance. The outer entrance, of course, is quite far from the harbor and could not be easily observed by the North Vietnamese. So they did not know whether we dropped 3, 4 or 500. The threat was what stopped the ships from going out through the field, not the number of mines*.

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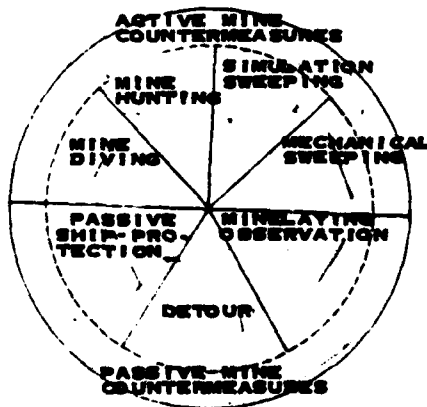
* Vice Admiral W.P. Mack, U.S. Navy Retirer, during the mining of Haiphong in May 1972 Commander of the 7th US Fleet in Proceedings, August 1980)

The problem of mine countermeasures cannot be stated more briefly and specifically than with these three sentences by Vice Admiral W.P. Mack (US Navy). With this statement he addresses the essence of the problem complex also of the NATO navies in the European area.

Now in Germany (FRG) as a country dependent upon overseas reinforcement and supply transports, whose total coastline is suitable for the deployment of sea mines, we have always devoted particular attention to mine countermeasures. It is certainly for this reason that in regard to the number of mine countermeasures units, variety of mine countermeasures techniques and progressiveness in mine countermeasures technologies we have always been in the forefront.

BASIC INFORMATION ON MINE COUNTERMEASURES

Mine countermeasures is still frequently equated with minesweeping and then immediately the reference is to good seamanship, otters (cutting paravanes), sweeping cables, launching buoys and on hard physical work. However, these imaginations are too simplified and have become obsolete. Mine countermeasures is defined as a part of the mine warfare within naval warfare, specifically as the totality of all measures and means for combatting enemy mining operations. A basic distinction can be made between offensive and defensive mine countermeasures (Fig. 1).



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All measures are included in the category of offensive mine counter- /72 measures, which are used to prevent enemy minelaying operations: the destruction of the production facilities and the destruction of the enemy minelaying capability and the laying of minefields.

Active and passive measures are included in defensive mine countermeasures. The passive measures include the observation of minelaying, the passive ship protection and navigational detour of shipping traffic. The active measures include mechanical sweeping, simulation sweeping, mine hunting and mine diving. Defensive mine countermeasures will now be described and evaluated.

MINE COUNTERMEASURES - MISSION OF THE GERMAN (FRG) NSVY

After the reader has become familiar with mine warfare and operational equipment from the first two articles, it will be easier for him to understand that different methods of elimination are required for the different types of sea mines. These will now be considered more comprehensively.

MECHANICAL SWEEPING

With the mechanical device otters spread one or two steel lines (sweeping lines) apart, which are supported by floats. A depth control paravane (otter) sets the steel lines at specified depth. With the lines a sawing action is obtained at a high speed on the mooring anchor and the mooring is cut through. The mine floats to the surface and can be destroyed. In order to improve the sawing effect, the sweeping lines are equipped with cutting grippers or explosive cutters. With the cutter gripper the steel line is cut by two blades; with the explosive cutter a small charge explodes, when the sweeper line touches the explosive cutter. Both cutters separate the anchor from the mine casing.

The mechanical sweeper can be deployed by a single ship or by several ships in formation. Precise navigation and superior shiphandling are the basic predication for the successful employment of this device.

SIMULATION BY TOWED DEVICES

Towed simulation devices are intended to activate the firing devices of remote firing mines - usually groundmines, but moored anchor mines - and cause the detonation of the explosive charge. The sweeper devices are so far astern that the detonation triggered by them scarcely hazards the mine hunter. /73

A distinction is made between magnetic and acoustic remote controlled sweeping devices. Magnetic remote controlled sweeper devices generate magnetic fields which are similar to ship magnetic fields and are provided with current from generators on board the sweeping ship. With these simulation devices those ignition (firing) devices are activated, which respond to a change of the earth magnetic field because of a ship. These are the loop sweep, the magnetic electrode sweep and the solenoid influence sweep.

The Loop Sweeper: This device generates in a floating cable, which is deployed in a large loop behind the minehunter, strong magnetic fields, which with control devices can rapidly change field strength and polarity and thereby represent the sequence of the passage of a ship over the site of a mine in abbreviated time repeatedly. This device is used in greater water depths.



Fig. 2: Four ships are included in the TROIKA minesweeping system. A guidance ship and three solenoid influence sweep ships.

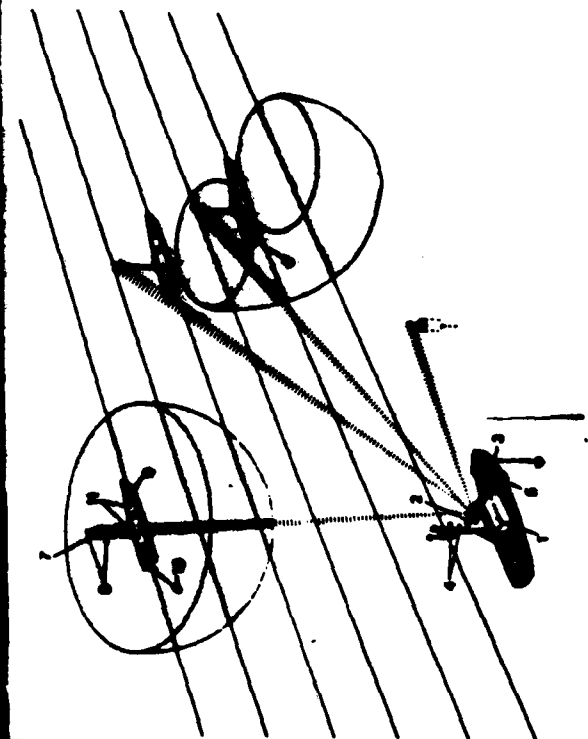


Fig. 3: Remoted controlled minesweeping with solenoid influence sweep.

- A) GUIDANCE SHIP
- 1) OPERATIONS CENTER
- 2) GUIDANCE RADAR ANTENNA
- 3) REMOTE CONTROL RADAR SYSTEM
- 4) REMOTE CONTROL SYSTEM
- 5) SONAR SYSTEM
- 6) SOLENOID
- 7) LUNING REFLECTOR
- 8) REMOTE CONTROL ANTENNA
- 9) NOISE GENERATOR (AVERAGE TONE
- 10) NOISE GENERATOR (DEEP TONE
- 11) MAGNETIC MINESWEEPING SYSTEM

The magnetic electrode sweep: This device consists of a floating cable ^{/73} towed astern and long bare electrodes. The current flowing through the cable, the electrodes and the salt water generates magnetic fields, whose strength and polarity can also be controlled. These devices are well suited because of their maneuverability for narrow waters.

The solenoid influence sweep: This floating cylindrical object, which is ca. 20 meters long has large coils, which are provided with current from the ship and can generate magnetic fields. The solenoid influence sweep is towed by the minehunter to the operational area. It is particularly well suited for navigationally difficult waters and permits high operating speeds.

The second group of sweeps is that of the acoustic remote control sweeps. They utilize the fact that the mine firing systems also respond to the noise spectrum of moving ships. In this regard certain typical frequency ranges can be used for activating acousting mine firing devices. These characteristic radiations are imitated by the acoustic remote control sweep. The sweeps used are the acoustic-electrical sweep, the acoustic turbine and the acoustic exploder.

The acoustic electrical device: This device is towed far behind the minesweeper. The acoustic noise generation can be controlled by an electrical control device and a power supply cable in such a manner, that many ship passages can be simulated within a short period of time. ^{/74}

The acoustic turbine: This device generates noise radiations only mechanically. A turbine is driven by the wake of the ship - independently of the speed of the minesweeper ship - and causes thereby a hammering and striking against the housing of a metallic head.

The acoustic exploder: This device can in particular be used for protection of the minesweeper ships. It generates by ejecting a series of explosive charges of various powers a noise rise and fall, which can cause the activation of simple mine firing (ignition) devices.



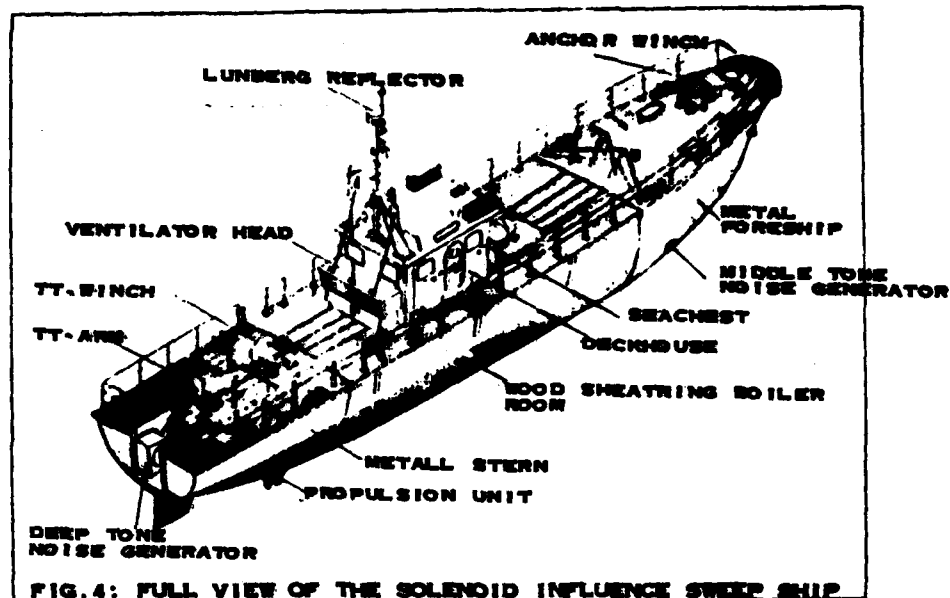
FIG. 7: MECHANICAL SWEEP



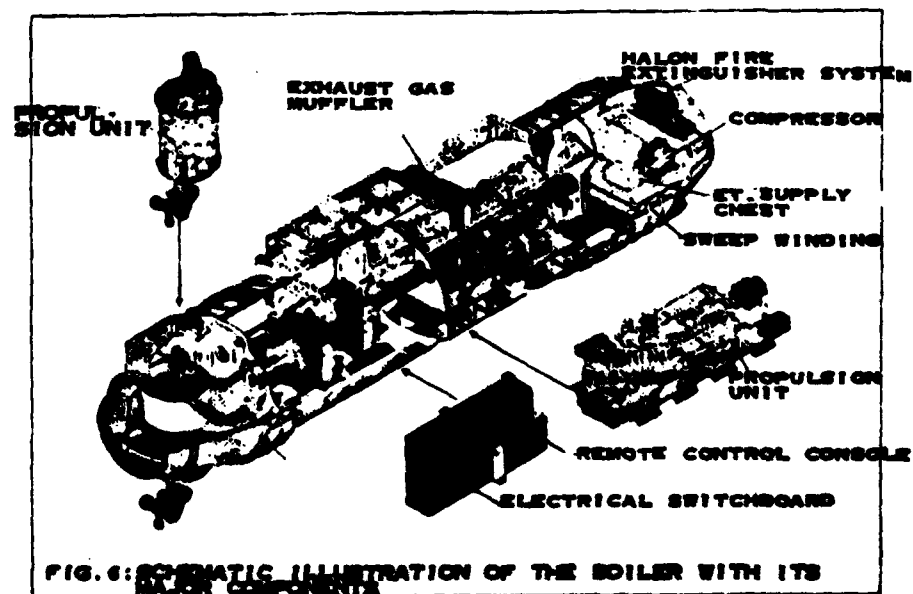
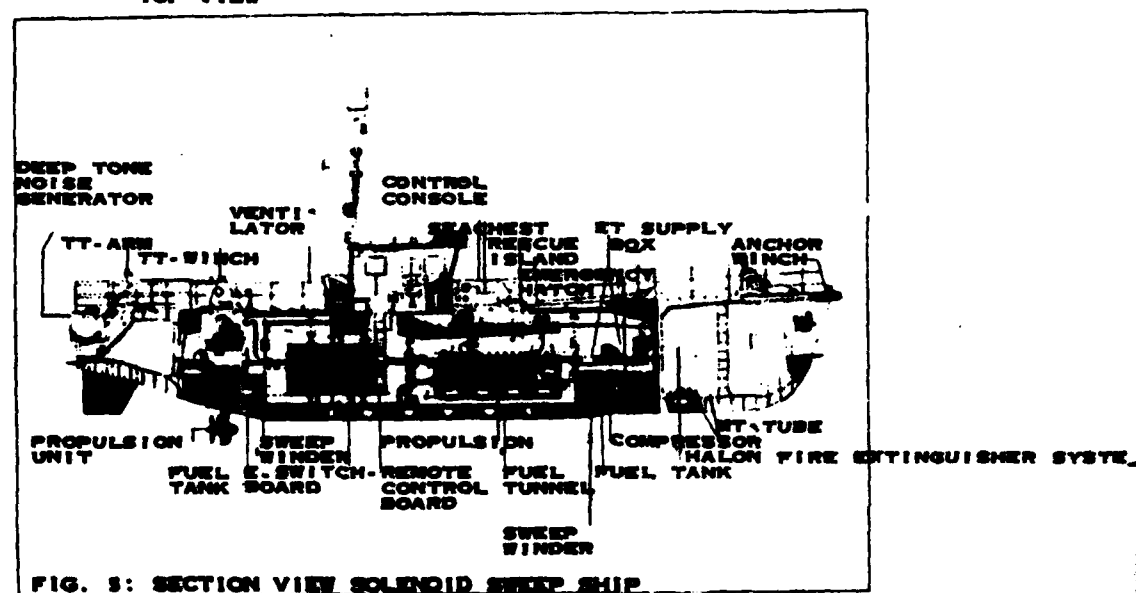
FIG. 8: ACOUSTIC TURBINE



FIG. 9: UNDERWATER DRONE



TOP VIEW



In the German (FRG) Navy sweeping is performed basically with a combined sweep. This means that a minesweeper tows of the devices shown an acoustic and a magnetic sweep simultaneously.

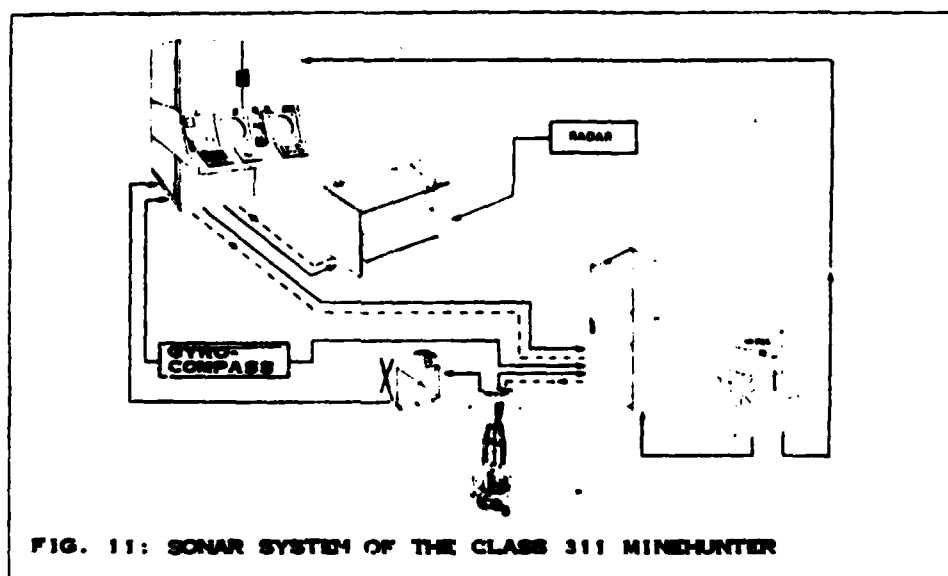
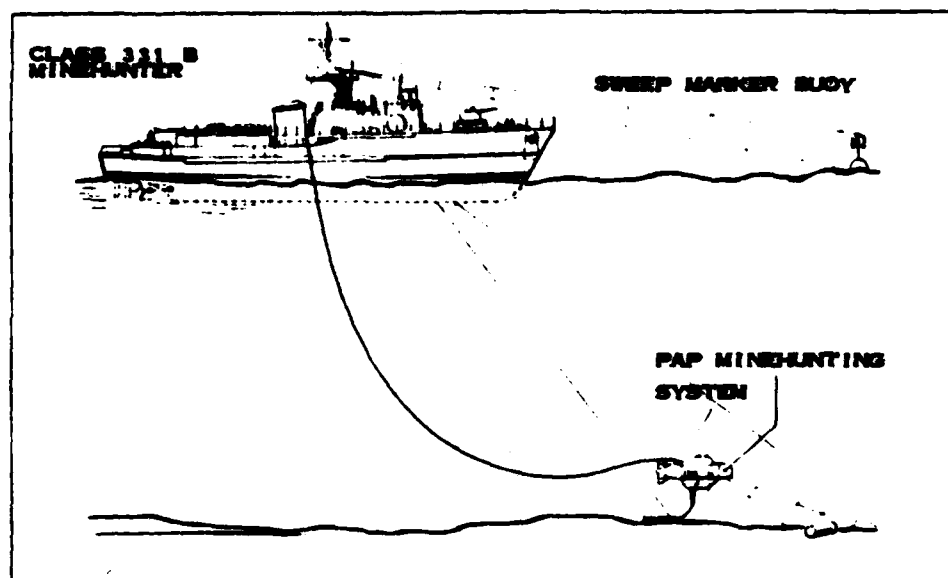


FIG. 11: SONAR SYSTEM OF THE CLASS 311 MINESWEEPER

SIMULATION WITH SURFACE DRONES

Whereas the methods of mine countermeasures were already used in principle in WWII, they were developed in the methods shown further only after WWII. It is of course a particular disadvantage in the towed sweeps that the towing ship itself must first overrun the mine, before the towed sweep ignites and can therefore eliminate the mine.

The later ministerial counselor Henning must have had the old saying in mind "Whoever sweeps mines is close to God", when he was prosecuting a new development. At the beginning of the 1960's he suggested the idea of a "remote controlled solenoid influence sweep" to the then Commander of Minesweepers, the Kapitän zur See and later Fleet Admiral Wolfgang Haack. At that time he suggested that two of these solenoid sweep ships should be controlled at the same time. Haack replied that it was already possible to guide three of these devices simultaneously, i.e., as a TROIKA, and that it would be more economic this way. With this the weapon system solenoid sweep ship Class 351, which is colloquially called TROIKA, was born. /75

The weapon system consists of a guidance ship and three surface drones, as the remote-controlled solenoid sweeps can be termed today. The ca. 500 ts guidance ship and the three ca. 100 ts drones constitute a tactical unit. With the guidance system in the operations center of the guidance ship the control and monitoring of the drones is provided. For self-protection the guidance ship is also equipped with a sonar, which can detect and classify moored anchor mines. The detected moored anchor mines can either be avoided by detouring or can be cut with the towed paravane (otter).



FIG. 3: VIEW INSIDE THE OPERATIONS CENTER OF A MINE HUNTER.

In operation the drones are guided parallel to each other over the sweep area by the guidance ship. The hull of the drones can be magnetized and generates the magnetic field required to activate the mines. The critical acoustic frequencies are covered by three noise generators.

With the capability of the simulation of magnetic and acoustic characteristics of ships, the drone is intended to detonate mines at the greatest possible and therefore safest distance. However, even at rather close range the drones should be able to survive a detonation without without major damage because of their design.

In summary it can be noted that with the capability of simulation by surface drones two decisive improvements have been realized as compared to the simulation by towed sweeps: the reduction of the hazard for the ship and crew and the increase of the efficiency by the simultaneous operation of the three solenoid sweeps.

MINEHUNTING

In the British Navy as well in the years after WWII research was conducted as to how the disadvantages of the minehunting methods to date could be eliminated. The recommendation went in a totally different direction as that described with the TROIKA. The British used the SONAR used in submarine detection, i.e., and underwater sonic detection method, in order to detect and eliminate mines. They converted a coastal minewsweeper for this purpose and began the first tests on the HMS SHOULTON. These tests were performed in the first half of the 1960's. In this minehunting technique the mine threat is for the first time detected in front of the ship, before it is engaged. In broad strokes, the system operates as follows:

With a high-frequency SONAR, which is optimized specially for detecting rather small objects, the sea floor is searched in a specific sector forward. The signal received is displayed on a screen and evaluated with receivers and preamplifiers. In the event of a possible mine contact the signal is stored and when it appears again is analyzed. The second analysis is then performed with another sonar signal and as appropriate identifies the mine contact. Then an underwater drone or a mine diver is sent to the mine contact for identification, elimination or recovery.

The required basic conditions for the operation of this system are provided by a series of other modern technologies:

- ▼ A precise positioning (term: dynamic anchoring) is obtained by modern auxiliary drives;
- ▼ The accurate position and navigation accuracy and a high degree of protection against interference are provided by new precision navigation instruments such as the satellite navigation;
- ▼ The information acquisition and information transmission by underwater drones is realized with a highly sophisticated microprocessor technology.

The minehunting methods have major advantages over the minesweeping methods and are superior to these in many regards:

- ▼ The pressure mine, which previously could not be swept, now has a counter method;
- ▼ The mines are no longer run over; ship and crew are safer;
- ▼ Firing system, counting systems and other auxiliary settings no longer apply, since the minehunter detects and eliminates the mine body"
- ▼ By neutralizing and recovering mines, information on mine setting and enemy mine development can be obtained.

Finally, the minehunter is considerably faster in eliminating the mine hazard than the minesweeper. The capability, already in peacetime to analyze the shipping lanes with sonar and to record the sea bottom cartographically attributes to this capability to a high degree. In wartime then only a comparison of the previous to the current conditions between the stored recordings and the actual examinations of the sea bottom are required.

The operational limitations of minehunting are usually determined by the sea bottom, to an extent also by the sonic propagation conditions in the water. The detection of mines is not longer possible with the previously used equipment, when the mines have sunk into mud or when they are covered with sand. In broken sea bottom with crevices and cracks or with stony bottom minehunting is very difficult.

Detailed information is available for all of these geophysical parameters and facilitate the selection of the most effective anti-mine agency in the particular area of operations. /7

MINE DIVING

Mine divers complete the broad spectrum of the mine countermeasures components of the German (FRG) Navy. They are used either within the parameters of minehunting - as already illustrated - or are used independently of other systems.

Mine divers have the task of locating mines at water depths of the continental shelf, to identify, recover and to eliminate such mines. This can happen both at anchorages in the open sea or in harbor approaches, harbor berths or in canal locks. For this mission mine divers are equipped with anti-acoustic and anti-magnetic diving equipment and have their own operational ships: mine diver ships and trucks. Hand sonar devices, portable decompression chambers, rubber boats with non-magnetic outboard engines, navigational equipment and various tools and equipment for eliminating mines are included in the outfitting of the mine divers.

PASSIVE MINE COUNTERMEASURES

After the capabilities of active mine countermeasures have been quite extensively described, now the passive mine countermeasures will be discussed. Mine laying observation, detour of traffic over non-mined sea areas and the passive ship protection are included in this category.

Minelaying Observation: "A known danger is half the danger - mine-laying observation can be paraphrased in this manner. Observing and reporting minelaying operations of enemy aircraft or surface units, so that immediately and in the most possibly exact position the appropriate mine countermeasures technique can be employed is the intent of this method. Many military and civilian agencies can perform this function: the naval ships themselves located in the sea area, the coastal radar system, light ship crews, official ships (Border Defense, Customs, Water Police, Navigation And Shipping Administration) and the radar-controlled shipping control in the estuaries of for example the Elbe, Weser, Jade and Ems

Detour: In the open sea, where there is not the restriction of narrow channels, the rerouting of a merchant ship convoy around a mined zone can save considerably more time than in stopping the convoy until the sweeping operation is completed.

Passive Ship Protection: A basic predication for mine countermeasures is a low acoustic and magnetic hazard level, since these ships by virtue of their mission have to approach mines and already expose themselves to danger.

Now the development of passive ship protection has made considerable progress. Wooden construction of the ships, anti-magnetic mess gear, dipole-compensated engines, a magnetic self protection system (MES) and much more have in the interim become standard, in order to counter the magnetic component of the mines. As possibilities for limiting magnetic radiation there are cited: mounting the engines on bonded (cushioned metal) sound absorbing coating of the outer skin of the ship and noise-minimized propellers). These and a number of other techniques have in the interim to a large extent been incorporated in minesweepers and minehunters, and are realized to an increasing degree in new construction or renovations of other fleet units.

The point of departure of the mine countermeasures flotillas of almost all navies is the mine countermeasures, which were already employed in WWII and which were thereafter further developed. In the new developments minehunting is in particular in the foreground.

NATO NAVIES

In the NATO navies the mine countermeasures methods are uniform to the extent that they can operate on the basis of common tactical regulations. Naturally, this does not preclude a slightly differentiated concentration contingent upon the geography of the particular pertinent sea zone. In this regard, combined minehunting-minesweeper ships are being procured by the British Navy, which selectively and contingent upon the geophysical conditions can tow minesweeping equipment or can employ their minehunting equipment. These ships either supplement or replace the coastal minesweepers of the TON Class, which to a large extent have been converted to minehunters.



FIG. 13: MINE DIVERS HAVE LOCATED A GROUND MINE AND MARKED IT WITH A BUOY.

The French Navy is particularly involved in minehunting. After already in the first half of the 1970's it commissioned the first new construction minehunters with the CIRCE Class, the French Navy is currently building the "Chasseur des mines tripartite" (Tripartite Minehunter), a joint project with the Belgian and Dutch Navies. With its high-performance sonar systems, the improved underwater drone, and integrated navigation system, the computer-controlled data acquisition, evaluation and processing, this ERIDAN Class is certainly the most modern mine countermeasures type in the world. The Danes and the Norwegians are beginning or have begun with the replacement of their standard minesweepers.

In the American Navy the emphasis in mine sweeping has been minesweeping with helicopters for many years. In this regard, as with minesweepers, sweeps are towed, which simulate acoustic and magnetic ship fields and are thereby intended to detonate mines. These devices can either be deployed by a minesweeper and then be taken over by the helicopter, or the helicopter can deploy the device itself. A pick-up of mine sweeping equipment which is on the beach and is then towed to the area of operations by the helicopter is also possible. The American Navy has

also rediscovered the "shipborne minecountermeasures" in recent years and is planning the new construction of mine countermeasures ships in the coming years.

The Standing Naval Force Channel (STANAFORCHAN), which has been in existence for ca. 10 years, is the organization for the common mine countermeasures tasks of NATO and for the interoperability of the different weapon systems of most of the NATO navies. In this organization, which is directed alternately by a British, a Belgian, a Dutch, or currently, by a German officer, mine countermeasures ships from the UK, The Netherlands, Belgium and the FRG are combined, which from time to time are supplemented by ships from the USA, Norway and Denmark.

WARSAW PACT NAVIES

The navies of the Warsaw Pact, particularly the Baltic Red Banner Fleet (BF), the Polish Fleet and the Volksmarine (Popular Navy) of the GDR (NVA-VM) have a large number of primarily conventional minesweepers. A large variety of types can be noted particularly in the Baltic Red Banner Fleet. Here tests have been performed for several years with mine detection equipment on acoustic or electro-magnetic basis. The sweeping of mines by helicopter has been practiced by the BF for many years and was also observed in the clearing of the Suez Canal, in which mine warfare forces from the USA, France, the UK and the Soviet Union participated. The Polish fleet (PSF) and the GDR Navy (NVA-VM) have minesweepers, which tow mechanical devices and devices for the simulation of acoustic and magnetic ship fields. The PSF has large numbers of mine divers.

PROSPECTS

The mine countermeasures technologies employed today are being constantly improved by the initiative of military technical engineers and the development of components in the civilian sector. Some prospective or possible developments will be cited in conclusion.

TECHNOLOGICAL DEVELOPMENT

With the introduction of microprocessors, mines have become considerably more complex and sweeping mines has become correspondingly more difficult. Naturally, the development of mine countermeasures components or systems must be adapted to this. In this regard, it is logical to proceed from the basic premise that "Knowing is better than believing", i.e., that it is better when after a minehunter operation a naval commander can determine that a sea zone is free of mines than when after a minesweeper operation he has to assume (believe) that the sea zone is free of a mine hazard.

Consequently, the greatest efforts are being exerted in the area of technological development in minehunting. An improvement of the sonar systems, a possible expansion of the areas suitable for minehunting by the employment of underwater drones, the considerable improvement of the effectiveness by integrated navigation systems and computer-controlled minehunting documentation systems are areas of emphasis in research and development in this regard.

Another area addresses the principle of the previous special minesweeper (guinea pig ship). This development, which is called ERMIS (Explosion Resistant Multi Influence Sweep System), is intended not only

to activate the acoustic and magnetic components of a mine, but the pressure components as well and can therefore simulate all mines. In this regard, ERMIS is intended itself to be essentially protected against mine detonations, which occur under the ship.

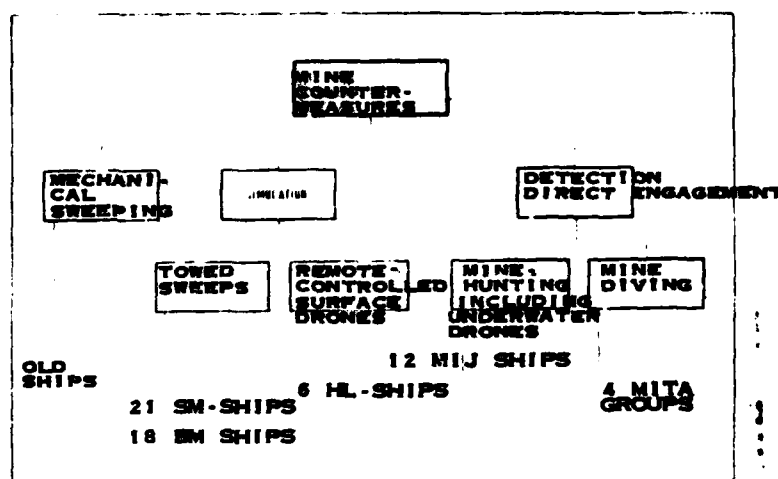


FIG. 14: ACTIVE MINE COUNTERMEASURES

Finally, the further development of the surface drones is noted. Here, however, the experience with the first units of this weapon system has to be obtained, before the further development as appropriate can be prosecuted more intensively.

PLANNING IN THE GERMAN (FRG) NAVY

The German (FRG) NAVY with its planning in this area is paying attention to the recognized and defined mine threat and the possible new technologies. The philosophy is that a multiplicity of mines has to be countered with a multiplicity of methods (Fig. 14).

The fast Type 343 coastal minesweeper/minelayer is in this regard intended to assume the still critical task of simulation sweeping with towed devices, while the Type 332 minehunters are intended to accommodate the point of emphasis of mine countermeasures - minehunting. A new Class, the Type 355 minesweeper, will then - contingent upon the development of components in the interim domestically and abroad - supplement the units of the Classes 343 and 332.

In regard to the mine divers, the issue is to improve the navigation capabilities and the detection capabilities under water. □